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IN THE
Supreme Court of the United States
OCTOBER TERM, 1994

BRUCE BABBITT, SECRETARY OF THE INTERIOR, *et al.*,
Petitioners,

v.

SWEET HOME CHAPTER OF COMMUNITIES FOR A GREAT OREGON, *et al.*,
Respondents.

On Writ of Certiorari to the United States Court of Appeals for the District of Columbia Circuit

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BRIEF OF AMICI CURIAE SCIENTISTS JOHN CAIRNS, JR., HAMPTON L. CARSON, JARED M. DIAMOND, THOMAS EISNER, STEPHEN JAY GOULD, DANIEL H. JANZEN, JANE LUBCHENCO, ERNST MAYR, CHARLES D. MICHENER, GORDON H. ORIANS, STUART L. PIMM, DANIEL SIMBERLOFF, JOHN W. TERBORGH, EDWARD O. WILSON IN SUPPORT OF PETITIONERS

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QUESTION PRESENTED

WHETHER HABITAT DESTRUCTION, WHICH IS THE MAJOR CAUSE OF SPECIES EXTINCTION, "HARMS" ENDANGERED SPECIES WITHIN THE MEANING OF SECTION 9 OF THE ENDANGERED SPECIES ACT OF 1973?

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BRIEF OF AMICI CURIAE SCIENTISTS IN SUPPORT OF PETITIONERS

INTERESTS OF *AMICI CURIAE*

Amici are prominent scientists in the field of biology, zoology, entomology, paleontology, and ecology. They have special knowledge of the habitat needs of endangered species, and issues directly before this Court. *Amici* believe the court below reached sweeping conclusions of law based upon unfounded and scientifically insupportable suppositions regarding the manner in which endangered species may be harmed. Species are "harmed," within any reasonable scientific definition of that term, by significant modification or degradation of habitat, especially where

habitat modifications actually kill or injure wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering, as provided in the Endangered Species Act (ESA) regulations defining harm. 50 C.F.R. § 17.3.

Amici include, in alphabetical order:

John Cairns, Jr., University Distinguished Professor of Environmental Biology, and Director of the University Center for Environmental and Hazardous Materials Studies, Virginia Polytechnic Institute and State University. Dr. Cairns is past Curator of Limnology at the Academy of Natural Sciences of Philadelphia, has served on 17 National Research Council committees, two as chair, and is presently serving on 14 editorial boards. He has over 1200 publications, including 48 books.

Hampton L. Carson, Professor Emeritus of Genetics, Department of Genetics and Molecular Biology, John A. Burns School of Medicine, University of Hawaii at Manoa. Dr. Carson's research has focused on evolutionary genetics, cytogenetics, population genetics, and the evolution of *Drosophila*.

Jared M. Diamond, Professor and Vice Chair, Department of Physiology, UCLA Medical School. Dr. Diamond is an explorer of New Guinea bird fauna, and inventor of the concept of assembly rules in community organization. Although his formal training was in physiology and membrane biophysics, Dr. Diamond has pursued a parallel career in ecology and evolutionary biology. Since 1977, he has devoted much of his time to popular science writing including the recently published book *The Third Chimpanzee*.

Thomas Eisner, Jacob Gould Professor of Biology, and Director of the Institute for Research in Chemical Ecology, Cornell University. Dr. Eisner is the founder of chemical ecology. He currently serves as an advisor for World Resources Institute, Committee for the National

Institutes of the Environment, and Center for Plant Conservation, and is former president of the American Society of Naturalists, and Chairman of the Section of Biology of the American Association for the Advancement of Science.

Stephen Jay Gould, Alexander Agassiz Professor of Zoology, Professor of Geology, and Curator of Invertebrate Paleontology at the Museum of Comparative Zoology, Harvard University. Dr. Gould has been awarded over thirty honorary doctoral degrees, and has received numerous literary awards for such renowned natural history books as *The Panda's Thumb* and *Wonderful Life.* He has popularized evolutionary biology, and originated the thesis of punctuated equilibrium.

Daniel H. Janzen, Professor of Biology, University of Pennsylvania. Dr. Janzen has spent the past 28 years focusing on the interactions between animals, particularly insects, and plants, and pioneering research to regenerate the deciduous forests of Central America. He initiated the parataxonomist program at the National Institute of Biodiversity in Costa Rica, training rural Costa Ricans in the basics of insect and plant taxonomy used in a national biodiversity program.

Jane Lubchenco, Distinguished Professor of Zoology, Oregon State University. Dr. Lubchenco is President-Elect of the American Association for the Advancement of Science, past President of the Ecological Society of America, and was named Oregon Scientist of the Year in 1994 by the Oregon Academy of Sciences. She is a Pew Scholar in Conservation and the Environment, a MacArthur Fellow, and her research on biodiversity of seaweeds and plant-herbivore interactions was named a Science Citation Classic.

Ernst Mayr, Alexander Agassiz Professor of Zoology, Emeritus, at the Museum of Comparative Zoology, Harvard University. Dr. Mayr is the architect of Neo-Darwin-

ism and the biological-species concept. He has produced 640 publications (including 16 books) in biology, ornithology, evolution, and systematics, including the influential *Systematics and the Origin of Species, Animal Species and Evolution,* and *Principles of Systematic Zoology,* and is a receipient of the National Medal of Science, the Balzan Prize, and a dozen honorary degrees.

Charles D. Michener, Watkins Professor Emeritus of Entomology, and Systematics and Ecology, University of Kansas. Dr. Michener has received two Guggenheim fellowships and a Fulbright research grant. His principal research fields include bee behavior, bee systematics, and principles of systematics, and he has over 375 publications.

Gordon H. Orians, Ecologist and Conservation Biologist, Department of Zoology, University of Washington. Dr. Orians' publications are focused on the fields of behavioral ecology, plant-herbivore interactions, community ecology, the ecology of rare plants, and human ecology.

Stuart L. Pimm, Professor of Zoology, University of Tennessee. Dr. Primm is a theoretical population biologist and ecologist, 1993 Pew Scholar in Conservation and the Environment, and author of *The Balance of Nature? Ecological Issues in the Conservation of Species and Communities.* He leads projects protecting endangered species in Hawaii and Florida.

Daniel Simberloff, Robert O. Lawton Distinguished Professor of Biological Science, Florida State University. Dr. Simberloff is a Fellow of the American Academy of Arts and Sciences, and a member of the Board of Governors of the Society for Conservation Biology. He serves on the editorial board of numerous scientific publications, and is the author of 161 scientific papers. He is a pioneer of island biogeography, and has published original research on the effects of habitat fragmentation on extinctions and the species-area curve.

John W. Terborgh, Director of the Center for Tropical Conservation, Duke University. In 1992, Dr. Terborgh was a MacArthur Fellow, and Pew Scholar in Conservation and the Environment. He is a botanist and a zoologist, and has operated a field station in the Manu National Park in Peru since 1973, where he has overseen the research of more than 100 investigators.

Edward O. Wilson, Curator of Entomology at the Museum of Comparative Zoology, and Frank B. Baird Jr. Professor of Science, Harvard University. Dr. Wilson's research interests include evolutionary sociobiology, biogeography, and ethical philosophy. He has written over a dozen books including *On Human Nature* and *The Ants* for which he was awarded Pulitizer Prizes in 1979 and 1991, respectively. His most recent book, *The Diversity of Life,* has been described as the sequel to Darwin's *Origin of Species.*

SUMMARY OF ARGUMENT

As scientists who have devoted our professional lives to the study of nature, and to the conservation of biological diversity for the benefit of humanity, we are deeply troubled by the Court of Appeals decision that habitat modification does not constitute "harm" within the meaning of the Endangered Species Act (ESA). Habitat loss is the major cause of species extinction in the United States and throughout the world. The rate of extinction is accelerating in direct response to the relentless destruction, degradation, and fragmentation of habitat, especially in the tropical forests, but here in the United States as well. As *Amicus* Edward O. Wilson has said, "The one process now going on that will take millions of years to correct is the loss of genetic species diversity by the destruction of natural habitat." [1] And it is we humans who cause this phenomenon.

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[1] Edward O. Wilson, *Biophilia,* Harvard University Press, 121 (1984).

This loss of biological wealth ought to concern us all gravely. Although we have discovered only a fraction of the species that exist, and have studied but a small proportion of those, we already have realized great benefits in terms of food, medicine and other valuable products. Yet we may never know what other benefits are being lost—what new miracle drug or pest-resistant food crop lies waiting to be discovered in some unlikely place—because we are destroying species and ecosystems faster than we can catalog them. At the most basic level, we are destroying knowledge when we extirpate a species. The tragedy is that much of this loss could be avoided by developing a better data base on biological resources and carefully planning human activities to avoid or at least reduce their impact.

Against this backdrop of the need for even stronger protections for our beleaguered natural world, we are utterly at a loss to understand how a statute with the stated purpose of "providing a means whereby the ecosystems upon which threatened and endangered species depend may be conserved," 16 U.S.C. § 1531(b), could be read to exclude protection of habitat on "nonfederal" lands that is being destroyed, degraded, and fragmented by unrestrained human activity. This is particularly disturbing when one considers that as many as half of all listed species are known to occur *only* on nonfederal lands. In some cases, entire ecosystems may exist only on nonfederal lands. We are not inclined to attribute to Congress an intent to write off all of this biological wealth on the speculative notion that its conservation would necessarily entail an undue burden on private property. Surely, some accommodations can be reached to avoid an either/or approach to the issue.

We understand that reasonable people—and courts—can disagree over the meaning of language. This case is certainly proof of that. But when it comes to the issue of whether habitat modification actually harms species, there

is no ambiguity in our minds. Extinction truly is the final environmental insult.

In our view, the Court of Appeals was wrong to focus its discussion of harm on the "direct application of force against the animal taken." 17 F.3d 1463, 1465 (D.C. Cir. 1994). In science, it matters little whether the fatal blow is delivered directly or indirectly, with malice aforethought or simple ignorance. Even the malicious killing of a single member of one of the most endangered species is not as deadly as the mistaken eradication of its last remaining habitat. It is the loss of the species that matters most in terms of biological diversity, and it is the conservation of habitat that matters most in terms of species survival and recovery.

There is no other law like the ESA. No law so boldly states the commitment to respect all forms of life, and strives to understand the human role in evolution. If the ESA does not protect habitat, wherever it be found, then it does not protect species, and it cannot succeed.

ARGUMENT

I. MORE THAN THE SURVIVAL OF INDIVIDUAL SPECIES IS AT STAKE IN THIS CASE: THE NATION'S COMMITMENT TO PRESERVING ITS BIOLOGICAL WEALTH IS ON THE LINE.

A. The Extinction Crisis.

We live in an era of extinction.[2] No one knows for certain how many species there are in the world, or the precise number that are disappearing daily from our midst. But there is general scientific consensus that we are losing global biodiversity at an accelerating rate, perhaps as many as 50 to 150 species *per day*.[3] If these trends con-

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[2] Edward O. Wilson, *The Diversity of Life*, W.W. Norton and Co., 280 (1993) (hereafter, *Diversity of Life*).

[3] W.V. Reid and K.R. Miller, *Keeping Options Alive: The Scientific Basis For Conserving Biodiversity*, World Resources Insti-

tinue, over a million species may vanish by the turn of the century.[4] Unless tropical deforestation is halted, we face the loss of 25 percent of the world's biological diversity by the year 2020.[5]

Of course, mass extinctions have happened before during earth's geological history, but this one is different. This is not the work of nature; it is the work of humans. Human population is growing at an exponential rate—5.6 billion today, an estimated 10 billion by 2050.[6] In response, resource consumption and waste disposal are escalating. The consequences for biodiversity are frightening. Current rates of extinction of birds and mammals are perhaps 1000 times what they would be in unperturbed nature.[7]

The loss can be measured many ways. Whole categories of organisms that emerged over the past 100 million years, among them condors, rhinoceros, manatees, and gorillas, are close to the end.[8] Humans rely in countless ways upon the goods and services nature provides. When we take a prescription to the pharmacy, there is a 50/50 chance that the medicine we take home was derived from

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tute, 37 (1989) (hereafter, *"WRI"*). The authors note that extinction rates vary considerably, but there is general consensus among scientists that whatever the precise rate, it is without precedent in recorded history.

[4] Peter H. Raven, "Our Diminishing Tropical Forests," in *Biodiversity* (Edward O. Wilson and Frances M. Peter eds.), National Academy Press, 119-122 (1988).

[5] *WRI, supra* note 3, at 45. Most of this loss would result from tropical deforestation.

[6] Laurie Ann Mazur, ed., *Beyond the Numbers: A Reader on Population, Consumption, and the Environment, Island Press,* 106 (1994).

[7] *WRI, supra* note 3, at 33.

[8] *Biophilia, supra* note 1, at 122.

a wild organism.[9] The commercial value of these medicinal products is more than $15 billion per year in the U.S. alone.[10] And this is just the tip of the iceberg. Of the estimated 30 million species that inhabit the earth, only a fraction (5%) have been identified, let alone studied for their beneficial properties, and yet many will disappear before we even know what has been lost.[11]

Some of the discoveries have been dramatic. From the rosy periwinkle, a nondescript tropical plant, came a breakthrough drug (vincristine) to treat childhood leukemia. From the humble Pacific yew, once burned as "slash" in the old growth forests of the Pacific Northwest, came taxol, a cancer fighting drug. From a simple willow came aspirin; from a lowly mold came penicillin; from common foxglove came the heart medicine digitalis. Even lethal species have their redeeming qualities. The venom of snakes and spiders provides us with useful antidotes. The desert pupfish, with its remarkable tolerance for extremes in temperature and salinity, may provide clues to understanding human kidney disease.[12]

Agricultural productivity is heavily dependent upon genetic diversity which, in turn, depends upon the preservation of habitat. It is essential that we conserve the areas where the wild relatives and diverse varieties of domesticated species grow. If this supply of genetic material is lost, cross-breeding to enhance agricultural produc-

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[9] Norman Meyers, *A Wealth of Wild Species: Storehouse for Human Welfare*, Westview Press, ix (1983).

[10] *Id.* at 5. This figure is based upon pre-1983 data, and is therefore likely to be understated.

[11] Testimony of Dr. Thomas Eisner, "Medicinal Uses of Plants: Protection For Plants Under the Endangered Species Act," *Hearing Before the Subcommittee On Environment and Natural Resources of the Committee on Merchant Marine and Fisheries, U.S. House of Representatives*, 103d Congress, 1st Session, Nov. 9, 1993, at 3.

[12] Meyers, *supra* note 9, at 116-117.

tivity will be impossible.[13] Such cross-breeding has been critical to the success of American agriculture. From 1930 to 1980, the use of genetic diversity accounted for at least one-half of a doubling in yields of rice, barley, soybeans, wheat, cotton, and sugar-cane; a three-fold increase in yields of corn, sorghum, and potato.[14] Genetic diversity is also a key to controlling pests. Due to evolutionary adaptation, pests are remarkably resistant to chemical controls. More than 400 species of pest now resist one or more pesticides,[15] and the proportion of U.S. crops lost to insects has approximately doubled—to 13 percent—since the 1940's, despite a two-fold increase in the use of pesticides.[16]

As important as diversity is at the genetic and species level, it takes on even greater significance at the ecosystem level. Natural aggregations of species are more than a collection of genetic material; they also provide ecological processes of enormous importance to humanity. Ecological processes include primary production (photosynthesis), decomposition, and maintenance of biogeochemical cycles (water, energy, nutrients and other chemical elements). The services these processes provide include maintenance of soil fertility, pest control, climate regulation, and pollution control.[17] Forested watersheds provide a useful example of the utilitarian value of the environmental services nature provides. The forest anchors the soil, controlling erosion and preventing flooding; it holds water,

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[13] *WRI, supra* note 3, at 25.

[14] Office of Technology Assessment, *Technologies to Maintain Biological Diversity*, OTA-F-330, United States Government Printing Office (1987).

[15] Robert May, "Evolution of Pesticide Resistance," 241 Nature 1441-49 (1985).

[16] Donald L. Plucknett and Nigel J.H. Smith, "Sustaining Agricultural Yields," 36 BioScience 40-45 (1986).

[17] *WRI, supra* note 3, at 4.

replenishing streams and aquifers and maintaining the hydrologic cycle; it stores carbon, helping reduce harmful atmospheric loadings; it provides habitat for commercially valuable species of fish—salmon in the Pacific Northwest, for example—and wildlife; and it helps purify the air. Remove the forest, through unrestrained clearcut logging, for example, and the ecological and economic consequences, though they may take time to manifest themselves, can be devastating. For an extreme example of this one need only consider the sad case of Haiti, once one of the richest colonies in the French empire, with exports greater than all combined exports from the American colonies, and now the poorest nation in the Western Hemisphere.[18] Though Haiti shares the island of Hispaniola with the Dominican Republic, and the two countries have much in common culturally and geographically, Haiti's domestic product per capita is only one-fourth the Dominican Republic's. The major difference is that Haiti has lost 90 percent of its forest, whereas the Dominican Republic, while perhaps not a model of conservation efforts, took firm measures to halt deforestation in time to avert the disasters that have befallen Haiti.

Closer to home, there are numerous examples of watershed degradation leading to serious economic harm. In the Douglas fir forests of the Pacific Northwest, the wholesale liquidation of the old growth forest that led to the listing of the northern spotted owl as a threatened species has also contributed to the catastrophic decline of the anadromous salmon fishery, once valued at $5 billion per year.[19] Excessive timber cutting in the headwaters of the Bull Run watershed on the Mt. Hood National Forest in Oregon has also reduced and contaminated the water

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[18] Thomas Lovejoy, "Species Leave the Ark One by One," in *The Preservation of Species*, B. Norton (ed.), Princeton University Press, 18-19 (1986).

[19] Steven Yaffe, *Lessons from the Spotted Owl*, Island Press, 21-45 (1993).

supply of the City of Portland, requiring it to install costly water treatment systems and purchase alternative water supplies.[20]

In sum, although the Court of Appeals showed little appreciation for the severity of the extinction problem, it is, in the truest sense of the word, a crisis. And it is not simply a crisis in the tropical forest, where half the world's biological diversity exists. Other ecosystems are under tremendous stress.

Freshwater habitats are being dramatically altered as rivers are impounded, and exotic species are introduced. In the Southeastern United States, for example, 40 to 50 percent of freshwater snails have been driven to near extinction, as a result of rivers being impounded, channelized and "straightened."[21] Forty percent of Hawaii's endemic plant species are threatened with extinction. Fifty-four percent of the nation's wetlands have been destroyed.[22] Twenty-five percent of our mangrove swamps have been lost to development and pollution. Every one of the desert fishes found in the Western United States is either currently listed or considered eligible for listing as a threatened or endangered species.[23]

Since the time of European settlement, some 500 species, subspecies and varieties have become extinct in the United States.[24] As of August, 1994, there are 895 domestic species of plants and animals (roughly evenly

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[20] G. Gregory Nokes, "Running Out At Bull Run," The Oregonian, D-1 (January 2, 1995).

[21] *WRI, supra* note 3, at 87.

[22] *Id.* at 127-28.

[23] Williams, et al., "Fishes of North America, Endangered, Threatened, or of Special Concern: 1989," 14 Fisheries 2-20 (American Fisheries Society) (1989).

[24] Council on Environmental Quality, *Twenty-First Annual Report*, 136-38, United States Government Printing Office (1990) (hereafter, *CEQ Report*).

divided) on the threatened or endangered list.[25] Another 3000 to 4000 are under consideration for listing.[26] Even relatively common species, such as songbirds and waterfowl, are experiencing sharp population declines due in part to habitat loss.[27] Alteration of the Everglades has reduced its wading bird population by 90 percent since 1947.[28] Truly, our wildlife heritage is in grave danger.

B. Habitat Loss Is the Major Cause of Extinction.

The data show that extinctions of plant and animal species have been rising in rough proportion to the loss of habitat.[29] As Michael E. Soulé, one of the leading conservation biologists of the day, has written: "Never in the 500 million years of terrestrial evolution has this mantle we call the biosphere been under such savage attack." [30]

Habitat loss, degradation, and fragmentation are the most important influences upon species extinction rates. Some 67 percent of all endangered, vulnerable and rare species of vertebrates (including fish), are threatened by habitat degradation or loss.[31] Habitat loss and degrada-

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[25] *Endangered Species Technical Bulletin*, U.S. Department of Interior, Fish and Wildlife Service, at 24 (July/August 1994).

[26] *CEQ Report, supra* note 24, at 136.

[27] *Diversity of Life, supra* note 2, at 256. ("From the 1940's to the 1980's, population densities of migratory songbirds in the mid-Atlantic United States dropped 50 percent, and many species became locally extinct.")

[28] Keith Schneider, "Returning Part of Everglades to Nature for $700 Million," The New York Times, March 11, 1991, at B10.

[29] William Ophuls and A. Stephen Boyan, Jr., *Ecology and the Politics of Scarcity Revisited*, 121, W. H. Freeman (1992).

[30] Michael E. Soulé and Brue A. Wilcox, *Conservation Biology*, Sinauer Associates, 7 (1987).

[31] Robert Prescott-Allen and Christine Prescott-Allen, *Sourcebook For a World Conservation Strategy: Threatened Invertebrates*, General Assembly Paper (United Nations Doc. GA 78110) (1978).

tion is an important factor in 90 percent of extinctions of freshwater fishes.[32]

The dusky seaside sparrow provides a stark case study of the deadly consequences of piecemeal habitat destruction.[33] First discovered in 1872, the dusky seaside sparrow thrived in its marsh habitat on Merritt Island, Florida, until human settlement began to encroach. Habitat alteration started in the 1920's. To control mosquitoes, the marshes were diked, flooding the sparrow's nesting habitat; to create pastures for cattle, the natural vegetation was burned, reducing its insect prey base; and to protect the livestock forage insecticides were sprayed, contaminating its food supply. By the late 1960's all that remained of its habitat were isolated patches in a sea of agricultural fields, and the dusky seaside sparrow was officially listed as an endangered species. In 1972, the State of Florida decided to build the Beeline Expressway through the heart of its last stronghold. Fill for the road was excavated from its habitat, leaving a landscape pockmarked with borrow pits and studded with spoil piles—a moonscape to a species that evolved in the pancake flat, organically rich marshes of coastal Florida. In 1975, in a last ditch effort to rescue the dusky seaside sparrow, the U.S. Fish and Wildlife Service created the St. John's National Wildlife Refuge on a tiny strip of land on Merritt Island. But even as the Service began acquiring the last bits of habitat, the population was spiraling downward. Between 1970 and 1979 the number of singing males surveyed plummeted from 143 to 9. A catastrophic series of wildfires—fueled by the dry pastures on the converted marshes—finished the job. In 1981 the five dusky

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[32] *Diversity of Life, supra* note 2, at 254.

[33] This account is taken from Herbert Kale, "A Status Report on the Dusky Seaside Sparrow," Bird Conservation, University of Wisconsin Press (1983); and Charles Cadieux, "The Dusky Seaside Sparrow," *These Are The Endangered,* The Stone Wall Press, Inc. (1982) (hereafter, *Cadieux*).

seaside sparrows remaining in the wild—all males, unfortunately—were taken into captivity. In 1987, Orange Band, the last member of its species, quietly passed into history, in a cage at Disney World.[34]

The dusky seaside sparrow did not perish from any direct injury. It was not hunted for sport or killed out of spite. It was not the victim of any intentional act. The species died because its habitat was taken, a piece at a time, each increment justified to meet human needs, but with the end result the loss of a unique form of life.

The red-cockaded woodpecker may be facing a similar fate. This bird is a cavity nester, requiring mature pine trees of 60 years or more with heartwood that has been softened by the "redheart" fungus, allowing for excavation. Once common across the southeastern region of the country, its population has steadily declined as industrial logging spread through the region, removing stands of mature southern pine and replacing them with even-aged tree farms.[35] In 1986, the total size of the breeding population was estimated to be about 6000. Since then, the population has been declining by as much as 10 percent per year, a rate that obviously spells disaster unless recent conservation efforts—spurred by the ESA—are successful.[36]

Stepping back from concerns over the fate of individual species, there is a broader point to make regarding the importance of habitat. Scientists have been studying the relationship betwen habitat size, population viability and species diversity for a very long time. In a seminal work published in 1967, *amicus* Edward O. Wilson and his colleague, Robert MacArthur, described the theory of island biogeography, which posited that the number of

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[34] Mark Jerome, *A Shadow and a Song*, Chelsea Green Publishing Co., 173 (1987).

[35] *Cadieux, supra* note 33, at 95-9.

[36] *Diversity of Life, supra* note 2, at 229.

species tended to decline as habitat patches became smaller and more isolated. The authors concluded that extinction vulnerability is primarily a function of population size. This relationship has come to be known as the species-area curve.[37] A useful rule of thumb is that if habitat is reduced by 90 percent in area, roughly one-half of its species will be lost.[38] Though imperfect, the species-area curve is a useful tool to gauge the effect of habitat loss on the population size of species.

For example, in a comparison of fragmented versus unfragmented chaparral habitat in San Diego County, California, researchers determined, using the species-area curve, that approximately 75 extinctions of bird populations had occurred in 36 fragments over an 80-year period.[39] The fragments were not large enough to support viable populations, resulting in a series of local extinctions culminating in extinctions region-wide. In another Southern California study, scientists surveyed native and introduced plant species in 25 isolated patches of coastal scrub vegetation. Using statistical analyses, the researchers concluded that, "Area was the single most important predictor in native plant species richness."[40]

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[37] *Diversity of Life, supra* note 2, at 221. The Species-Area equation is $S = CA^z$, where S = the number of species, A = area and C and z are constants. The exponent *z* determines the slope of the curve and is the critical parameter in estimating extinction rates. Like any model, the species-area curve depends upon the accuracy of the assumptions made regarding the rate and pattern of, for example, deforestation, and the degree to which any conservation efforts are applied. The existence of a relationship between habitat loss and species extinction is, however, unquestionable.

[38] *WRI, supra* note 3, at 35.

[39] Douglas T. Bolger, *et al.*, "Occurrence Patterns of Bird Species in Habitat Fragments: Sampling Extinction and Nested Species Subsets," The American Naturalist (Feb. 1991).

[40] Allison S. Alberts, *et al.*, "Effects of Habitat Fragmentation on Native and Exotic Plants in Southern California Coastal Scrub," in *Interface Between Ecology and Land Development in California*, Southern California Academy of Sciences (1993).

C. Loss of Habitat on Nonfederal Lands Threatens Up to Half of Currently Listed Species with Extinction.

The Court of Appeals apparently thought that Congress meant to distinguish between federal and nonfederal lands [41] in terms of the habitat conservation requirements of the ESA. Specifically, the D.C. Circuit ruled that Congress intended to limit habitat conservation efforts on nonfederal lands to just two narrow provisions of the ESA.[42] One is through the Section 5 acquisition program, 16 U.S.C. § 1534; the other is through the Section 7 consultation process that applies to federal agencies.[43] However, since the majority of activity that occurs on nonfederal lands does not involve federal action, the practical effect of the Appeals Court's decision is to open the door to precisely the sort of habitat fragmentation that led to the extinction of the dusky seaside sparrow. It does not appear that the Appeals Court fully appreciated the consequences of this ruling, and it casts a dark cloud over the fate of a number of endangered species.

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[41] The term nonfederal land includes land owned by private parties, nonprofits, state and local governments, and Indian tribes.

[42] 17 F.3d 1463, at 1466 ("The Act addresses habitat preservation in two ways—the federal land acquisition program and the directive to federal agencies to avoid adverse impacts.")

[43] Among other things, Section 7 requires federal agencies to consult with the Fish and Wildlife Service and the National Marine Fisheries Service when their actions may affect listed species, and to insure that such actions are not likely to jeopardize the continued existence of such species or result in the adverse modification or destruction of designated critical habitat. 16 U.S.C. § 1536(a)(2). Although nonfederal lands can sometimes be protected as critical habitat, such designations have limited applicability. Critical habitat on nonfederal lands is protected only from the effects of federal or federally-permitted activities that are included in a consultation under Section 7. Only 105 species have habitat designated as critical, and 80 of these have a portion of their critical habitat on nonfederal lands. U.S. General Accounting Office, "Endangered Species Act: Information on Species Protection on Nonfederal Lands," GAO/RCED-95-16, U.S. Government Printing Office, 4-5 (Dec. 1994) (hereafter *GAO Report*).

Two recent studies prepared for Congress reveal just how critical nonfederal habitat is to the survival of many species. In one, the Nature Conservancy looked at all the documented occurrences of listed species and determined that approximately 50 percent were found *only* on nonfederal land.[44] The study also found that 64 percent of the known occurrences for all listed species are on nonfederal land. Most recently, the U.S. General Accounting Office found that more than 90 percent of listed species have some or all of their habitat on nonfederal lands, and 34 percent of suitable habitat for listed species is found *entirely* on nonfederal lands.[45] Removing the protection of habitat on nonfederal lands from significant degradation places these species at serious risk.

The Court of Appeals reasoned that if the government wants to protect habitat on nonfederal lands it can simply buy it. 17 F.3d 1463, at 1466. Since close to two-thirds of the land base of the United States is nonfederal, this would be a daunting undertaking, to say the least. Clearly, Congress intended acquisition to be one of the tools employed in the effort to rescue imperiled species, but it strains credulity to suggest that Congress saw massive federal acquisition as the solution to the endangered species problem.

The actual experience under the acquisition program shows that Congress had something less grandiose in mind. Between 1967 and 1993, the U.S. spent $253.900.761 to purchase 359,755 acres for endangered species protection.[46] Though substantial, these acquisitions hardly begin to address the need to maintain the habitat on nonfederal

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[44] Natural Heritage Data Center Network, *Perspectives on Species Imperilment* 5, The Nature Conservancy (1993).

[45] *GAO Report, supra* note 43, at 4-5.

[46] *Fish and Wildlife Land and Water Conservation Fund; Land Purchase Obligations FY 1967 through 1993*, Fish and Wildlife Service, U.S. Department of the Interior (1995). Document submitted under separate cover and lodged with the Clerk of this Court.

land that, according to the GAO, provides support for over 90 percent of listed species.[47] Indeed, the total acreage acquired by the federal government over the past 25 years does not even equal the habitat involved in the regional conservation plan for a single species, the California gnatcatcher.[48]

Of course, one could argue that the failure to appropriate more for acquisition simply reflects Congress' ambivalence about endangered species conservation.[49] Or perhaps Congress understood and accepted the fact that many species would probably become extinct because there was no meaningful protection for them off federal property. Rather than attribute such inconsistent purposes to Congress, however, there is another way to look at the issue; that is, that Congress in fact intended the government to use *all* of its powers in the effort to save endangered species and the ecosystems that support them. Support for that view is found in the Act itself, which defines the key term "conservation" as "the use of all methods and procedures which are necessary to bring endangered or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary."[50]

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[47] *GAO Report*, *supra* note 43, at 4.

[48] *See*, Special Rule Concerning Take of the Threatened Coastal California Gnatcatcher, 58 Fed. Reg. 65088 (Dec. 10, 1993). The conservation plan for the gnatcatcher calls for protection of 3.8 million acres of coastal scrub habitat under a voluntary public/private financing scheme.

[49] The history of the Act, however, does not support such an inference. Every time the ESA has been reauthorized, it has passed by overwhelming margins in both Houses of Congress. *See* 124 Cong. Rec. 31603 (July 19, 1978) (SENATE VOTE, 94 to 3); 124 Cong. Rec. 38159 (Oct. 14, 1978) (HOUSE VOTE, 384 to 12); 128 Cong. Rec. H3249 (June 8, 1982) (voice vote); 128 Cong. Rec. S6572 (June 9, 1982) (voice vote); 133 Cong. Rec. H11647 (Dec. 17, 1987) (399 to 16); 134 Cong. Rec. S10173 (July 28, 1988) (93 to 2).

[50] 16 U.S.C. § 1532(3). *See also Tennessee Valley Authority v. Hill*, 437 U.S. 153, 174 (1978) ("But examination of the language,

II. THE COURT OF APPEALS DECISION MAKES NEITHER BIOLOGICAL NOR COMMON SENSE: THE COURT'S INTERPRETATION OF "HARM" IS CONTRARY TO THE PLAIN MEANING OF THE WORD, INCONSISTENT WITH THE PURPOSES OF THE ACT, ANTITHETICAL TO GOOD SCIENCE, AND BASED ON QUESTIONABLE INFERENCES DRAWN FROM FRAGMENTS OF THE ACT'S LEGISLATIVE HISTORY.

Life is full of ambiguity, nowhere more so than in the use of language. In this case, the word "harm" is the focus of attention. In its ordinary usage, the word "harm" means to "injure" or "damage" something.[51] There is no question that habitat modification harms endangered species under this commonly accepted meaning of the word. In the most literal sense, habitat degradation and fragmentation kill species.

But the Court of Appeals did not view the issue quite so literally. Rather it expressed skepticism that Congress could have intended such a broad, albeit straightforward, application of regulatory authority over private property. In other words, the Appeals Court did not believe that Congress actually meant what it said in the ESA.

The Court of Appeals found great significance in the fact that the rest of the words in the definition of "take" in Section 3 (the company that "harm" was keeping), suggested that Congress did not intend to regulate all the activities that might injure species, but only those that do so through the *direct* application of force to the *individual members* of a species. 17 F.3d 1463, at 1465; 30 F.3d 190, at 193 (*per curiam* opinion denying petition

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history, and structure of the legislation under review here indicates beyond a doubt that Congress intended endangered species to be afforded the highest of priorities.")

[51] *See Webster's Third New International Dictionary*, 1034 (1986); *The Random House Dictionary of the English Language*, 873 (2d ed. 1987).

for rehearing). Thus, even if it were absolutely clear that the complete elimination of habitat would result in the extinction of an entire species—for example, destruction of the whooping crane's wintering grounds on the Texas Gulf Coast while the birds are on their breeding grounds in Canada—that habitat destruction would not, according to the Appeals Court, be subject to regulation under Section 9. On the other hand, an activity that annoyed an individual member of a species—for example, a tour boat getting too close to a whooping crane at Aransas National Wildlife Refuge in Texas—could be subject to criminal prosecution for "harassment" under Sections 3 and 9 of the ESA. This strange irony gives new meaning to the old adage, "The law locks up both man and woman who steals the goose from the common, but lets the greater felon loose who steals the common from the goose." [52]

As scientists, *amici* do not normally engage in statutory construction. Rather, we try to understand and communicate, as best we can, the science that underlies endangered species conservation efforts. But when a legal interpretation like the one at issue before this Court has such devastating consequences for the objects of our profession, we feel compelled to speak.

We first note that the explicit purpose of the ESA is to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved." 16 U.S.C. § 1531(b). This focus on ecosystems is entirely appropriate because it captures the need to preserve diversity at all its levels—from genetic, to species, to landscape scale. Ecosystems, of course, are not confined by political boundaries, or ownership patterns. Species cannot read "No Trespassing" signs. Habitat straddles many a fence line. Thus, attempting to divide ecosystems, for purposes of habitat conservation measures,

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[52] John Bartlett, *Familiar Quotations*, Fifteenth and 125th Anniversary Edition, Little Brown, 918 n.13 (1980).

between federal and nonfederal land is sheer folly. Many ongoing endangered species recovery plans would be doomed to failure if this were the law.[53]

Next, we note that the Act's definition of the critical term "conservation," set forth above, is all-encompassing. "All methods" sounds definitive. Congress could have said all "appropriate" methods, or "all methods except those that involve the regulation of habitat on nonfederal lands," but it did not. It said "all methods."

Turning to the specifics of the Court of Appeals decision, the most troubling aspect, from the scientific point of view, is its insistence that there be a *direct* injury to an *individual member* of a species. 17 F.3d 1463, at 1465; 30 F.3d 190, at 193 (*per curiam* opinion denying petition for rehearing). There simply is no biological basis for such artificial requirements.

First, species (including individuals) can be just as severely injured by indirect as by direct means. Take, for example, the use of registered pesticides. Unless carefully applied and monitored, pesticides have been known to cause secondary poisoning of nontarget, endangered species, such as bald eagles. *Defenders of Wildlife v. E.P.A.*, 882 F.2d 1294 (8th Cir. 1989). Or take the case of sea turtles that depend upon unobstructed access to sandy beaches to deposit their eggs. Though the phenomenon is not entirely understood, turtles are known to have very strong homing instincts which bring them back to traditional nesting areas year after year. Should nesting

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[53] *See e.g.*, P. Logan et al., Florida Panther Habitat Preservation Plan, Florida Panther Interagency Committee, U.S. Fish & Wildlife Service, 40 (Jan. 3, 1994): "This plan identifies the minimum habitat needed to support the South Florida population. Ongoing telemetry studies may show panther range shifts caused by habitat destruction from specific development projects. Some displaced animals may succumb to intraspecific aggression or highway mortality because of adverse habitat modification in their range. In such cases the U.S. Fish and Wildlife Service may seek to invoke Section 9 of the Endangered Species Act."

beaches be obstructed by a sea wall or boardwalk, for example, the returning turtles, laden with eggs, would have no place to nest. In the case of critically endangered sea turtles, nesting beaches are precious, and each reproductive failure moves the species one step closer to extinction.[54]

There are legions of examples of harm to species from indirect means. Drawing down water levels in aquifers is a clear threat to species, such as the devil's hole pupfish, that spawn on ledges that can be reached only when the water reaches a certain height. *Caeppart v. United States,* 426 U.S. 128 (1976). Anadromous salmon can neither spawn nor migrate if streams are blocked or dried up by withdrawals. *United States v. Glenn-Colusa Irrigation District,* 788 F. Supp. 1126 (E.D. Ca. 1992); *PUD No. 1 of Jefferson Co. v. Washington Dept. of Ecology,* —— U.S. ——, 114 S. Ct. 1900, 1913 (1944) ("a sufficient lowering of the water quantity in a body of water could destroy all of its designated uses, be it for drinking water, recreation, navigation or, as here, as a fishery.") Certain freshwater mussels start out life attached to the gills of a host fish—the fish is literally the first habitat of the mussel. Actions that limit or remove the host fish also impact the mussel. This is not a hypothetical scenario; as a group, freshwater mussels are among the most endangered species in the country in part due to decline of their hosts, resulting in turn from the loss of the host species' habitat.[55]

Second, the requirement that in order to be regulated an activity must directly injure an individual member of a species, as opposed to the species itself, strikes us as missing the forest for the trees. While it is true that every individual of an endangered species is important, and in

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[54] National Research Council, *Decline of the Sea Turtles: Causes and Prevention,* National Academy Press, 77-82 (1990).

[55] R.J. Neves and J.C. Widlak, "Habitat Ecology of Juvenile Fresh Water Mussels (Bivalvia: Unionidae) in a Head Water Stream in Virginia," 5 American Malacological Bulletin 1-7 (1987).

some cases critical to its survival, it is the viability of the *species* that is of vital importance. Whether an individual northern spotted owl is actually injured when its nest trees are being clearcut is not the sole or even the most pressing concern. Rather it is the permanent loss of suitable nesting habitat and the corresponding population decline that poses the greatest threat to the long term viability of the owl.

In sum, as scientists, we are concerned that the courts understand the scientific implications of their decisions. In this case the Court of Appeals clearly did not. Indeed we are at a loss to understand how the Court could have reached a conclusion so hostile to the very premises upon which the ESA operates.

III. THE ESA SHOULD BE INTERPRETED IN THE HISTORICAL CONTEXT OF THE GOVERNMENT'S SPECIAL TRUST RESPONSIBILITY TO CONSERVE WILDLIFE FOR THE BENEFIT OF THE PUBLIC.

Since Roman law, wildlife has been regarded as *res communes*—the property of everyone.[56] At English common law, wildlife was treated as *ferae naturae*; property rights did not accrue until wildlife had been lawfully reduced to possession. *Pierson v. Post*, 3 Caines 175 (Supreme Court of New York, 1805); *Hughes v. Oklahoma*, 441 U.S. 332 (1979).

Since wildlife, in its natural state, was no one's property, it fell to government to act as trustee for the benefit of the public to which wildlife did belong.[57] From its

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[56] *See*, Michael J. Bean, *The Evolution of National Wildlife Law* (revised and expanded edition), Praeger, 10-15 (1983).

[57] *In re Steuart Transportation Co.*, 495 F. Supp. 38, 40 (E.D. Va. 1980). "Under the public trust doctrine the State of Virginia and the United States have the right and the duty to protect and preserve the public's interest in national wildlife resources."

earliest days, American law acknowledged the authority and responsibility of government to look after the public's interest in its wildlife heritage. Writing in 1914, Dean Roscoe Pound observed that, "Recently a strong tendency has arisen with regard to running water and wild game as *res pulicae*; to hold that they are owned by the state, or better, that they are assets of society that are not capable of private appropriation or ownership except under regulations that protect the general social interest." [58] The ESA is only one of the more recent, and perhaps most eloquent, expressions of this public trust. Previous statutes have dealt with migratory waterfowl, bald and golden eagles, anadromous fish, wild horses and burros, aerial hunting of wolves, and marine mammals.[59]

The point is that there is a long history of wildlife conservation in this country. Modern wildlife management has always operated on the basis that government had a legitimate and crucial role to play in conserving habitat.[60] Sometimes the exercise of this authority has interfered with private uses of the land, but the courts have consistently upheld such regulations as necessary to protect the public *res*. In *Cerritos Gun Club v. Hall*, 76 F.2d 670 (9th Cir. 1938), for example, the court sustained a wildlife regulation despite the fact that it rendered "worthless" the improvements the landowner had made to attract wildlife to his property. Even Indian Treaty Rights, regarded as akin to property rights, must yield to conservation requirements. *Puyallup Tribe v. Washington Department of Game*, 414 U.S. 44, 49 (1973). (". . . the Treaty does not give the Indians a Federal right to pursue the last living steelhead until it enters their nets.")

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[58] Roscoe Pound, "The End of the Law as Developed in Legal Rules and Doctrines," 27 Harvard L. Rev. 195 (1914).

[59] *Bean, supra* note 56, at 1-40.

[60] Aldo Leopold, *Game Management*, University of Wisconsin, 2-21 (1934).

In sum, government not only has the right but the duty to protect the habitat of endangered species on federal and nonfederal lands.[61] While landowner concerns can and should be fairly dealt with,[62] the public interest must also be taken into account through the responsible exercise of legislative authority, such as the ESA. In this way we may yet avoid the biological impoverishment that threatens our world. As Aldo Leopold, an early pioneer in the field of ecology, said in describing his "land ethic": "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise." [63]

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[61] *See* Gary D. Meyers, "Variations on a Theme: Expanding the Public Trust Doctrine to Include Protection of Wildlife," 19 Envtl. L. 723 (1989).

[62] By all accounts, the ESA harm rule has not resulted in substantial violations of constitutional private property rights. No court has ruled that the ESA has taken private property in violation of the 5th Amendment. As of 1993, 12 years after the harm rule was promulgated, no cases had been filed even alleging a "taking" of real property. Congressional Research Service Report to Congress, *The Endangered Species Act and Private Property*, The Library of Congress (March 7, 1993) at 7.

[63] Aldo Leopold, *A Sand County Almanac*, Oxford University Press, 262 (1966).

CONCLUSION

The decision of the Court of Appeals should be reversed.

Respectfully submitted,

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